Excerpts From 180 NAC 6 for Veterinary Facilities

EFFECTIVE DATE NEBRASKA HEALTH AND HUMAN SERVICES
JULY 22, 2001 REGULATION AND LICENSURE 180 NAC 6
TITLE 180 CONTROL OF RADIATION

CHAPTER 6 X-RAYS IN THE HEALING ARTS

APPENDIX

ATTACHMENT

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CHAPTER 6 X-RAYS IN THE HEALING ARTS

6-001 SCOPE AND AUTHORITY

6-001.01 180 NAC 6 establishes requirements, for which a registrant is responsible, for use of x-ray equipment by or under the supervision of an individual authorized by and licensed in accordance with state statutes to engage in the healing arts or veterinary medicine. The regulations are authorized by and implement the Nebraska Radiation Control Act, Neb. Stat. Rev. sections 71-3501 to 3519.

6-001.02 The use of x-ray equipment for the intentional exposure of individuals for diagnosis or treatment shall be by or under the supervision of one licensed to practice the healing arts in Nebraska.

6-001.03 The use of x-ray equipment in the practice of veterinary medicine shall be by or under the supervision of an individual authorized to practice veterinary medicine in the State of Nebraska.

6-001.04 The provisions of 180 NAC 6 are in addition to, and not in substitution for, other applicable provisions of 180 NAC 1, 2, 4, 9, 10, 15, 16, 17 and 18.

6-002 DEFINITIONS: As used in Title 180, the following definitions apply:

Accessible surface means the external surface of the enclosure or housing provided by the manufacturer.

Added filtration means any filtration which is in addition to the inherent filtration.

Aluminum equivalent means the thickness of type 1100 aluminum alloy[1] affording the same attenuation, under specified conditions, as the material in question.

Assembler means any person assembling, replacing, or installing one or more components into an x-ray system or subsystem. It includes adjustment of components which affect output of radiation generating equipment. The term includes the owner of an x-ray system or his employee or agent who assembles components into an x-ray system that is subsequently used to provide professional or commercial services.

Attenuation block means a block or stack, having dimensions 20 centimeters by 20 centimeters by 3.8 centimeters, of type 1100 aluminum alloy[2] or other materials having equivalent attenuation.

[1]The nominal chemical composition of type 1100 aluminum alloy is 99.00 percent minimum aluminum, maximum 0.12 percent copper.

[2]Ibid.

Automatic exposure control means a device which automatically controls one or more technique factors in order to obtain at a preselected location(s) a required quantity of radiation (See also"Phototimer")

Barrier (See “Protective barrier”).

Beam axis means a line from the source through the centers of the x-ray fields.

Control panel means that part of the x-ray control upon which are mounted the switches, knobs, push-buttons, and other hardware necessary for manually setting the technique factors.

Deadman switch means a switch so constructed that a circuit closing contact can be maintained only by continuous pressure on the switch by the operator.

Diagnostic source assembly means the tube housing assembly with a beam-limiting device attached.

Diagnostic x-ray system means an x-ray system designed for irradiation of any part of the human body for the purpose of diagnosis or visualization.

Direct scattered radiation means that scattered radiation which has been deviated in direction only by materials irradiated by the useful beam (See "Scattered radiation").

Entrance exposure rate means the exposure per unit time at the point where the center of the useful beam enters the patient.

Equipment (See "X-ray equipment").

Field emission equipment means equipment which uses an x-ray tube in which electron emission from the cathode is due solely to the action of an electric field.

Filter means material placed in the useful beam to absorb preferentially selected radiations.

Fluoroscopic imaging assembly means a subsystem in which x-ray photons produce a fluoroscopic image. It includes the image receptor(s) such as the image intensifier and spot-film device, electrical interlocks, if any, and structural material providing linkage between the image receptor and diagnostic source assembly.

Focal spot means the area projected on the anode of the x-ray tube by the electrons accelerated from the cathode and from which the useful beam originates.

Half-value layer means the thickness of specified material which attenuates the beam of radiation to an extent such that the exposure rate is reduced to one-half of its original value. In this definition,

the contribution of all scattered radiation, other than any which might be present initially in the beam concerned, is deemed to be excluded.

HVL (See "Half-value layer").

Image intensifier means a device, installed in its housing, which instantaneously converts an x-ray pattern into a corresponding light image of higher energy density.

Image receptor means any device, such as a fluorescent screen or radiographic film, which transforms incident x-ray photons either into a visible image or into another form which can be made into a visible image by further transformations.

IInherent filtration means the filtration of the useful beam provided by the permanently installed components of the tube housing assembly.

Kilovolts peak (See "Peak tube potential").

kV means kilovolts.

kVp (See Peak tube potential).

Lead equivalent means the thickness of lead affording the same attenuation, under specified conditions, as the material in question.

Leakage radiation means radiation emanating from the diagnostic or therapeutic source assembly except for the useful beam.

Leakage technique factors means the technique factors associated with the diagnostic or therapeutic source assembly which are used in measuring leakage radiation. They are defined as follows:

1. For diagnostic source assemblies intended for capacitor energy storage equipment, the maximum-rated peak tube potential and the maximum-rated number of exposures in an hour for operation at the maximum-rated peak tube potential with the quantity of charge per exposure being 10 millicoulombs, i.e., 10 milliampere seconds, or the minimum obtainable from the unit, whichever is larger.

2. For diagnostic source assemblies intended for field emission equipment rated for pulsed operation, the maximum-rated peak tube potential and the maximum-rated number of x-ray pulses in an hour for operation at the maximum-rated peak tube potential.

3. For all other diagnostic or therapeutic source assemblies, the maximum-rated peak tube potential and the maximum-rated continuous tube current for the maximum-rated peak tube potential.

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Light field means that area of the intersection of the light beam from the beam-limiting device and one of the set of planes parallel to and including the plane of the image receptor, whose perimeter is the locus of points at which the illumination is one-fourth of the maximum in the intersection.

uC/kg means microcoulomb/kilogram.

mA means milliampere.

mAs means milliampere second.

mC/kg means millicoulomb/kilogram.

Mobile x-ray equipment (See X-ray equipment).

Peak tube potential means the maximum value of the potential difference across the x-ray tube during an exposure.

Phototimer means a method for controlling radiation exposures to image receptors by the amount of radiation which reaches a radiation monitoring device(s). The radiation monitoring device(s) is part of an electronic circuit which controls the duration of time the tube is activated (See "Automatic exposure control").

Primary protective barrier (See Protective barrier).

Protective apron means an apron made of radiation absorbing materials used to reduce radiation exposure.

Protective barrier means a barrier of radiation absorbing material(s) used to reduce radiation exposure. The types of protective barriers are as follows:

> Primary protective barrier means the material, excluding filters, placed in the useful beam, for protection purposes, to reduce the radiation exposure.
>
> Secondary protective barrier means a barrier sufficient to attenuate the stray radiation to the required degree.

Protective glove means a glove made of radiation absorbing materials used to reduce radiation exposure.

Qualified expert with reference to radiation protection, a person having the knowledge and training to measure ionizing radiation, to evaluate safety techniques, and to advise regarding radiation protection needs (for example, persons certified in this field by the American Board of Radiology, or the American Board of Health Physics, or those having equivalent qualifications). With reference to the calibration of radiation therapy equipment, a person having in addition to the above qualifications, training and experience in the clinical applications of radiation physics to radiation therapy (for example, persons certified in Radiological Physics or X-ray and Radium Physics by the

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American Board of Radiology, or those having equivalent qualifications) or meets the minimum qualifications specified in 180 NAC 15-013.03.

Radiograph means an image receptor on which the image is created directly or indirectly by an x-ray pattern and results in a permanent record.

Radiographic imaging system means any system whereby a permanent or semi-permanent image is recorded on an image receptor by the action of ionizing radiation.

Radiological physicist means an individual who meets the requirements of 180 NAC 15-013.01 Radiological Medical Physicist or 180 NAC 15-013.02 Radiological Health Physicist.

Recording means producing a permanent form of an image resulting from x-ray photons.

Scattered radiation means radiation that, during passage through matter, has been deviated in direction (See "Direct scattered radiation").

Secondary protective barrier (See "Protective barrier").

Source means the focal spot of the x-ray tube.

Spot film means a radiograph which is made during a fluoroscopic examination to permanently record conditions which exist during that fluoroscopic procedure.

Spot-film device means a device intended to transport and/or position a radiographic image receptor between the x-ray source and fluoroscopic image receptor. It includes a device intended to hold a cassette over the input end of an image intensifier for the purpose of making a radiograph.

SSD means the distance between the source and the skin of the patient.

Stationary x-ray equipment (See X-ray equipment).

Stray radiation means the sum of leakage and scattered radiation.

Technique factors means the conditions of operation. They are specified as follows:

1. For capacitor energy storage equipment, peak tube potential in kV and quantity of charge in mAs;

2. For field emission equipment rated for pulsed operation, peak tube potential in kV and number of x-ray pulses;

3. For all other equipment, peak tube potential in kV and either tube current in mA and exposure time in seconds, or the product of tube current and exposure time in mAs.

Tube means an x-ray tube, unless otherwise specified.

Tube housing assembly means the tube housing with tube installed. It includes high-voltage and/or filament transformers and other appropriate elements when such are contained within the tube housing.

Useful beam means the radiation emanating from the tube housing port or the radiation head and passing through the aperture of the beam-limiting device when the exposure controls are in a mode to cause the system to produce radiation.

Visible area means that portion of the input surface of the image receptor over which incident x-ray photons are producing a visible image.

X-ray control means a device which controls input power to the x-ray high-voltage generator and/or the x-ray tube. It includes equipment such as timers, phototimers, automatic brightness stabilizers, and similar devices, which control the technique factors of an x-ray exposure.

X-ray equipment means an x-ray system, subsystem, or component thereof. Types of x-ray equipment are as follows:

Mobile x-ray equipment means x-ray equipment mounted on a permanent base with wheels and/or casters for moving while completely assembled.

Portable x-ray equipment means x-ray equipment designed to be hand-carried.

Stationary x-ray equipment means x-ray equipment which is installed in a fixed location.

X-ray field means that area of the intersection of the useful beam and any one of the set of planes parallel to and including the plane of the image receptor, whose perimeter is the locus of points at which the exposure rate is one-fourth of the maximum in the intersection.

X-ray high-voltage generator means a device which transforms electrical energy from the potential supplied by the x-ray control to the tube operating potential. The device may also include means for transforming alternating current to direct current, filament transformers for the x-ray tube(s), high-voltage switches, electrical protective devices, and other appropriate elements.

X-ray system means an assemblage of components for the controlled production of x-rays, including, but not limited to, an x-ray high-voltage generator, an x-ray control, a tube housing assembly, a beam-limiting device, and the necessary supporting structures. Additional components which function with the system shall be considered integral parts of the system.

X-ray subsystem means any combination of two or more components of an x-ray system.

X-ray tube means any electron tube which is designed to be used primarily for the production of x-rays.

6-003 GENERAL REQUIREMENTS

6-003.01 Administrative Controls

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1. Registrant: The registrant shall be responsible for directing the operation of the x-ray system(s) under his administrative control. The registrant or the registrant's agent shall assure that the requirements of 180 NAC 6-003.01, item 1. are met in the operation of the x-ray system(s).

    a. An x-ray system which does not meet the provisions of Title 180 shall not be operated for diagnostic or therapeutic purposes, unless the Agency

makes a finding that its continued use will not constitute a risk to the health and safety of the public.

d. Written safety procedures shall be provided to each individual operating x-ray equipment, including any restrictions of the operating technique required for the safe operation of the particular x-ray system. The operator shall be able to demonstrate familiarity with these procedures.

(1) Doors that are an integral part of room shielding shall be closed during x-ray procedures; and
(2) The door in 180 NAC 6-003.01, item 1.d.(1). shall be posted "Close door during x-ray procedures".

i. Procedures and auxiliary equipment designed to minimize patient and personnel exposure commensurate with the needed diagnostic information shall be utilized.

(1) The speed of film or screen and film combinations shall be the fastest speed consistent with the diagnostic objective of the examinations.
(2) The radiation exposure to the patient shall be the minimum exposure required to produce images of good diagnostic quality.
(3) Portable or mobile x-ray equipment shall be used only for examinations where it is impractical to transfer the patient(s) to a stationary x-ray installation.

j. All individuals who are associated with the operation of an x-ray system are subject to the requirements of 180 NAC 4-0052 4-052 and 4-022. In addition:

(1) When protective clothing or devices are worn on portions of the body and a personnel monitoring device(s) is required, at least one such monitoring device shall be utilized as follows:

(a) When an apron is worn, the monitoring device shall be worn at the collar outside the apron.
(b) The dose to the whole body based on the maximum dose attributed to the most critical organ shall be recorded in the reports required by 180 NAC 4-052. If more than one device is used and a record is made of the data, each dose shall be identified with the area where the device was worn on the body.

(2) Exposure of a personnel monitoring device to deceptively indicate a dose delivered to an individual is prohibited.

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2. Information and Maintenance Record and Associated Information: The registrant shall maintain the following information for each x-ray system for inspection by the Agency:

a. Model and serial numbers of all certifiable components;
b. Aluminum equivalent filtration of the useful beam, including any routine variation;
c. Records of surveys, calibrations, maintenance, and modifications performed on the x-ray system(s) after June 27, 1983 with the names of persons who performed such services.
d. A scale drawing shall be available of the room in which a stationary x-ray system is located with such drawing indicating the use of areas adjacent to the room and an estimation of the extent of occupancy by an individual in such areas. In addition, the drawing shall include:

(1) The results of a survey for radiation levels present at the operator's position and at pertinent points outside the room at specified test conditions; or
(2) The type and thickness of materials, or lead equivalency, of each protective barrier; and

e. A copy of all correspondence with this Agency regarding that x-ray system.

6-003.02 X-Ray Log: Each facility shall maintain an x-ray log or chart containing the patient's name, the type of examinations, and the dates the examinations were performed. When the patient or film must be provided with human auxiliary support, the name of the human holder shall be recorded.

6-003.03 Plan Review

1. Prior to construction, the floor plans and equipment arrangement of all new installations, or modifications of existing installations, utilizing x-rays for diagnostic or therapeutic purposes shall be submitted to a qualified expert or the Agency for review and comment. The required information is denoted in Appendices 2 and 3 of 180 NAC 6.
2. The Agency may require the applicant to utilize the services of a qualified expert to determine the shielding requirements prior to the plan review and comment. For particle accelerator facilities the qualified expert shall be a radiological physicist.
3 The review of such plans shall not preclude the requirement of additional modifications should a subsequent analysis of operating conditions indicate the possibility of an individual receiving a dose in excess of the limits prescribed in 180 NAC 4-005, 4-011 and 4-013.

6-004 GENERAL REQUIREMENTS FOR ALL DIAGNOSTIC X-RAY SYSTEMS: In addition to other requirements of 180 NAC 6-004 all diagnostic x-ray systems shall meet the following requirements:

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6-004.01 Warning Label: The control panel containing the main power switch shall bear the warning statement, legible and accessible to view: "WARNING: This x-ray unit may be dangerous to patient and operator unless safe exposure factors and operating instructions are observed."

6-004.02 Battery Charge Indicator: On battery-powered x-ray generators, visual means shall be provided on the control panel to indicate whether the battery is in a state of charge adequate for proper operation.

6-004.03 Leakage Radiation from the Diagnostic Source Assembly: The leakage radiation from the diagnostic source assembly measured at a distance of l meter in any direction from the source shall not exceed 100 milliroentgens (25.8 uC/kg) in 1 hour when the x-ray tube is operated at its leakage technique factors. Compliance shall be determined by measurements averaged over an area of 100 square centimeters with no linear dimension greater than 20 centimeters.

6-004.04 Radiation from Components Other Than the Diagnostic Source Assembly: The radiation emitted by a component other than the diagnostic source assembly shall not exceed 2 milliroentgens (0.516 uC/kg) in 1 hour at 5 centimeters from any accessible surface of the component when it is operated in an assembled x-ray system under any conditions for which it was designed. Compliance shall be determined by measurements averaged over an area of 100 square centimeters with no linear dimension greater than 20 centimeters.

6-004.05 Beam Quality

1. Half-value Layer

   a. The half-value layer of the useful beam for a given x-ray tube potential shall not be less than the values shown in Table I. If it is necessary to determine such half-value layer at an x-ray tube potential which is not listed in Table I, linear interpolation or extrapolation may be made.

TABLE I

Design operating range (kVp)	Measured Potential (kVp)	Half-value layer (mm of aluminum)
Below 51	30	0.3
	40	0.4
	50	0.5
51 to 70	51	1.2
	60	1.3
	70	1.5
Above 70	71	2.1
	80	2.3
	90	2.5
	100	2.7
	110	3.0
	120	3.2
	130	3.5
	140	3.8
	150	4.1

b. The requirements of 180 NAC 6-004.05, item 1.a. will be considered to have been met if it can be demonstrated that the aluminum equivalent of the total filtration in the primary beam is not less than that shown in Table II.

TABLE II

Filtration Required vs. Operating Voltage

Operating Voltage (kVp)	Total Filtration (inherent plus added) (millimeters aluminum equivalent)
Below 50	0.5 millimeters
50 - 70	1.5 millimeters
Above 70	2.5 millimeters

d. Beryllium window tubes shall have a minimum of 0.5 millimeter aluminum equivalent filtration permanently installed in the useful beam.
e. For capacitor energy storage equipment, compliance with the requirements of 180 NAC 6-004.05 shall be determined with the maximum quantity of charge per exposure.
f. The required minimal aluminum equivalent filtration shall include the filtration contributed by all materials which are always present between the source and the patient.

2. Filtration Controls: For x-ray systems which have variable kVp and variable filtration for the useful beam, a device shall link the kVp selector with the filter(s) and shall prevent an exposure unless the minimum amount of filtration required by 180 NAC 6-004.05, item 1.a. is in the useful beam for the given kVp which has been selected.

6-004.06 Multiple Tubes: Where two or more radiographic tubes are controlled by one exposure switch, the tube or tubes which have been selected shall be clearly indicated prior to initiation of the exposure. This indication shall be both on the x-ray control panel and at or near the tube housing assembly which has been selected.

6-004.07 Mechanical Support of Tube Head: The tube housing assembly supports shall be adjusted such that the tube housing assembly will remain stable during the exposure unless the tube housing movement is a designed function of the x-ray system.

6-004.08 Technique Indicators

1. The technique factors to be used during an exposure shall be indicated before the exposure begins. If automatic exposure controls are used, the technique factors which are set prior to the exposure shall be indicated.
2. The requirement of 180 NAC 6-004.08, item 1. may be met by permanent markings on equipment having fixed technique factors. Indication of technique factors shall be visible from the operator's position except in the case of spot films made by the fluoroscopist.

6-004.09 Structural Shielding: Structural shielding shall be provided as necessary to meet the requirements of 180 NAC 4-005, 4-022, and 4-013.

6-005 FLUOROSCOPIC X-RAY SYSTEMS: All fluoroscopic x-ray systems shall meet the following requirements:

1. Primary Barrier

a. The fluoroscopic imaging assembly shall be provided with a primary protective barrier which intercepts the entire cross-section of the useful beam at any SID.
b The x-ray tube used for fluoroscopy shall not produce x-rays unless the barrier is in position to intercept the entire useful beam.

2. X-Ray Field

a. Use of nonimage-intensified fluoroscopic equipment shall not be used.
b. For image-intensified fluoroscopic equipment, neither the length nor the width of the x-ray field in the plane of the image receptor shall exceed that

of the visible area of the image receptor by more than 3 percent of the SID. The sum of the excess length and the excess width shall be no greater than 4 percent of the SID. In addition:

(1) Means shall be provided to permit further limitation of the field. Beam-limiting devices manufactured after May 22, 1979, and incorporated in equipment with a variable SID and/or a visible area of greater than 300 square centimeters shall be provided with means for stepless adjustment of the x-ray field;

(2) All equipment with a fixed SID and a visible area of 300 square centimeters or less shall be provided with either stepless adjustment of the x-ray field or with means to further limit the x-ray field size at the plane of the image receptor to 125 square centimeters or less. Stepless adjustment shall, at the greatest SID, provide continuous field sizes from the maximum obtainable to a field size of 5 by 5 centimeters or less;

(3) For equipment manufactured after February 25, 1978, when the angle between the image receptor and beam axis is variable, means shall be provided to indicate when the axis of the x-ray beam is perpendicular to the plane of the image receptor; and

(4) Compliance shall be determined with the beam axis indicated to be perpendicular to the plane of the image receptor. For rectangular x-ray fields used with circular image receptor, the error in alignment shall be determined along the length and width dimensions of the x-ray field which pass through the center of the visible area of the image receptor.

c. Spot-film devices which are certified components shall meet the following additional requirements, except when the spot-film device is provided for use with a radiation therapy simulation system:

(1) Means shall be provided between the source and the patient for adjustment of the x-ray field size in the plane of the film to the size of that portion of the film which has been selected on the spot-film selector. Such adjustment shall be automatically accomplished when the x-ray field size in the plane of the film is greater than that of the selected portion of the film. If the x-ray field size is less than the size of the selected portion of the film, the means for adjustment of the field size shall be only at the operator's option;

(2) It shall be possible to adjust the x-ray field size in the plane of the film to a size smaller than the selected portion of the film. The minimum field size at the greatest SID shall be equal to, or less than, 5 centimeters by 5 centimeters;

(3) The center of the x-ray field in the plane of the film shall be aligned with the center of the selected portion of the film to within 2 percent of the SID; and

(4) On spot-film devices manufactured after February 25, 1978, if the angle between the plane of the image receptor and beam axis is variable, means shall be provided to indicate when the axis of the x-ray beam is perpendicular to the plane of the image receptor, and compliance shall be determined with the beam axis indicated to be perpendicular to the plane of the image receptor.

6-005.02 Activation of the Fluoroscopic Tube: X-ray production in the fluoroscopic mode shall be controlled by a device which requires continuous pressure by the fluoroscopist for the entire time of any exposure. When recording serial fluoroscopic images, the fluoroscopist shall be able to terminate the x-ray exposure(s) at any time, but means may be provided to permit completion of any single exposure of the series in process.

6-005.03 Exposure Rate Limits

1. Entrance Exposure Rate Allowable Limits

a. The exposure rate measured at the point where the center of the useful beam enters the patient shall not exceed 10 roentgens (2.58 mC/kg) per minute, except during recording of fluoroscopic images or when provided with optional high level control.

b When provided with optional high level control, the equipment shall not be operable at any combination of tube potential and current which will result in an exposure rate in excess of 5 roentgens (1.29 mC/kg) per minute at the point where the center of the useful beam enters the patient unless the high level control is activated.

(1) Special means of activation of high level controls shall be required. The high level control shall only be operable when continuous manual activation is provided by the operator.
(2) A continuous signal audible to the fluoroscopist shall indicate that the high level control is being employed.

c. In addition to the other requirements of 180 NAC 6-005, certified systems which do not incorporate an automatic exposure rate control shall not be operable at any combination of tube potential and current which will result in an exposure rate in excess of 5 roentgens (1.29 mC/kg) per minute at the point where the center of beam enters the patient except during recording of fluoroscopic images or when provided with an optional high level control.

d. Compliance with the requirements of 180 NAC 6-005.03 shall be determined as follows:

(1) Movable grids and compression devices shall be removed from the useful beam during the measurement.
(2) If the source is below the table, exposure rate shall be measured 1 centimeter above the tabletop or cradle.
(3) If the source is above the table, the exposure rate shall be measured at 30 centimeters above the tabletop with the end of the beam-limiting device or spacer positioned as closely as possible to the point of measurement.
(4) In a C-arm type of fluoroscope, the exposure rate shall be measured 30 centimeters from the input surface of the fluoroscopic imaging assembly.

e. Periodic measurement of entrance exposure rate shall be performed as follows:

(1) Such measurements shall be made annually or after any maintenance of the system which might affect the exposure rate.

(2) Results of these measurements shall be posted where any fluoroscopist may have ready access to such results while using the fluoroscope and in the record required in 180 NAC 6-003.01, item 2., c. The measurement results shall be stated in roentgens (C/kg) per minute and include the technique factors used in determining such results. The name of the person performing the measurements and the date the measurements were performed shall be included in the results.

(3) Personnel monitoring devices may be used to perform the measurements required by 180 NAC 6-005.03, item 1.e.(1), provided the measurements are made as described in 180 NAC 6-005.03, item 1, e.(4).

(4) Conditions of periodic measurement of entrance exposure rate are as follows:

(a) The measurement shall be made under the conditions that satisfy the requirements of 180 NAC 6-005.03, item 1.d.

(b) The kVp shall be the kVp typical of clinical use of the x-ray system;

(c) The x-ray system(s) that incorporates automatic exposure control shall have sufficient material placed in the useful beam to produce a milliamperage typical of the use of the x-ray system; and

(d) X-ray system(s) that do not incorporate an automatic exposure control shall utilize a milliamperage typical of the clinical use of the x-ray system. Materials should be placed in the useful beam when conducting these periodic measurements to protect the imaging system.[3]

6-005.04 Barrier Transmitted Radiation Rate Limits

1. The exposure rate due to transmission through the primary protective barrier with the attenuation block in the useful beam, combined with radiation from the image intensifier, if provided, shall not exceed 2 milliroentgens (0.516 uC/kg) per hour at 10 centimeters from any accessible surface of the fluoroscopic imaging assembly beyond the plane of the image receptor for each roentgen per minute of entrance exposure rate.
2. Measuring Compliance of Barrier Transmission

a. The exposure rate due to transmission through the primary protective barrier combined with radiation from the image intensifier shall be determined by measurements averaged over an area of 100 square centimeters with no linear dimension greater than 20 centimeters.

b. If the source is below the tabletop, the measurement shall be made with the input surface of the fluoroscopic imaging assembly positioned 30 centimeters above the tabletop.

c. If the source is above the tabletop and the SID is variable, the measurement shall be made with the end of the beam-limiting device or spacer as close to the tabletop as it can be placed, provided that it shall not be closer than 30 centimeters.

[3]Materials should be placed in the useful beam when conducting these periodic measurements to protect the imaging system.

d. Movable grids and compression devices shall be removed from the useful beam during the measurement.

e. The attenuation block shall be positioned in the useful beam 10 centimeters from the point of measurement of entrance exposure rate and between this point and the input surface of the fluoroscopic imaging assembly. Closer distances may be used if corrections are applied for poor geometry.

6-005.05 Indication of Potential and Current: During fluoroscopy and cinefluorography, the kV and the mA shall be continuously indicated.

6-005.06 Source-to-Skin Distance: The SSD shall not be less than:

1. 38 centimeters on stationary fluoroscopes installed after June 27, 1983,
2. 35.5 centimeters on stationary fluoroscopes which were in operation prior to November 23, 1990.
3. 30 centimeters on all mobile fluoroscopes, and
4. 20 centimeters for image intensified fluoroscopes used for specific surgical application. The written safety procedures must provide precautionary measures to be adhered to during the use of this device.

6-005.07. Fluoroscopic Timer

1. Means shall be provided to preset the cumulative on-time of the fluoroscopic x-ray tube. The maximum cumulative time of the timing device shall not exceed 5 minutes without resetting.
2. A signal audible to the fluoroscopist shall indicate the completion of any preset cumulative on-time. Such signal shall continue to sound while x-rays are produced until the timing device is reset. As an alternative to the requirements of this subpart, radiation therapy simulation systems may be provided with a means to indicate the total cumulative exposure time during which x-rays were produced, and which is capable of being reset between examinations.
3. The total time of exposure shall be recorded.

6-005.08 Mobile Fluoroscopes: In addition to the other requirements of 180 NAC 6-005, mobile fluoroscopes shall provide intensified imaging.

6-005.09 Control of Scattered Radiation

1. Fluoroscopic table designs when combined with procedures utilized shall be such that no unprotected part of any staff or ancillary individual's body shall be exposed to unattenuated scattered radiation which originates from under the table. The attenuation required shall be not less than 0.25 millimeter lead equivalent.
2. Equipment configuration when combined with procedures shall be such that no portion of any staff or ancillary individual's body, except the extremities, shall be exposed to the unattenuated scattered radiation emanating from above the tabletop unless that individual:

    a. Is at least 120 centimeters from the center of the useful beam, or
    b. The radiation has passed through not less than 0.25 millimeter lead equivalent material including, but not limited to, (drapes, Bucky-slot cover panel, or self-supporting curtains) in addition to any lead equivalency provided by the protective apron referred to in 180 NAC 6-003.01, item 1.e.

3. The Agency may grant exceptions to 180 NAC 6-005.09, item 2., where a sterile field will not permit the use of the normal protective barriers. Where the use of prefitted sterilized covers for the barriers is practical, the Agency shall not permit such exception.

6-010 VETERINARY MEDICINE RADIOGRAPHIC INSTALLATIONS

6-010.01 Equipment

1. The protective tube housing shall be equivalent to the requirements of 180 NAC 6-004.03.
2. Diaphragms or cones shall be provided for collimating the useful beam to the area of clinical interest and shall provide the same degree of protection as is required of the housing.
3. The total filtration permanently in the useful beam shall not be less than 0.5 millimeters aluminum equivalent for machines operating up to 50 kVp, 1.5 millimeters aluminum equivalent for machines operating between 50 and 70 kVp, and 2.5 millimeters aluminum equivalent for machines operating above 70 kVp.
4. A device shall be provided to terminate the exposure after a preset time or exposure.
5. A dead-man type of exposure switch shall be provided, together with an electrical cord of sufficient length, so that the operator can stand out of the useful beam and at least 6 feet (1.83m) from the animal during all x-ray exposures.

6-010.02 Structural Shielding: All wall, ceiling, and floor areas shall be equivalent to or provided with applicable protective barriers to assure compliance with 180 NAC 4-005, 4-011, and 4-013.

6-010.03 Operating Procedures

1. The operator shall be protected from the direct scatter radiation by a whole body protective barrier of 0.25 millimeter lead equivalent or shall be so positioned that the nearest portion of the body is at least 2 meters from the tube head and the nearest edge of the image receptor.
2. No individual other than the operator shall be in the x-ray room while exposures are being made unless such individual's assistance is required.
3. When an animal must be held in position during radiography, mechanical supporting or restraining devices should be used. If the animal must be held by an individual, that individual shall be protected with appropriate shielding devices, such as protective gloves and apron, and he shall be so positioned that no part of his body will be struck by the useful beam. The exposure of any individual used for this purpose shall be monitored.
4. Veterinary Assistant's Training Requirements. Effective November 15, 1990, veterinary assistant's shall have eight (8) hours of classroom instruction in the fundamentals of radiation safety, radiation detection instrumentation, radiographic equipment, state and federal regulations, operating and emergency procedures and case histories of radiography accidents as outlined in 180 NAC 15-024, "Minimum Training Requirements for Operators of Non-Human X-Ray" of Title 180.

INFORMATION ON RADIATION SHIELDING REQUIRED FOR PLAN REVIEWS

In order for the Agency to provide an evaluation, technical advice, and official approval on shielding requirements for a radiation installation, the following information must be submitted.

1. The plans should show, as a minimum, the following:

   (a) The normal location of the x-ray system's radiation port; the port's travel and traverse limits; general direction(s) of the useful beam; locations of any windows and doors; the location of the operator's booth; and the location of the x-ray control panel.

   (b) The structural composition and thickness or lead equivalent of all walls, doors, partitions, floor, and ceiling of the room(s) concerned.

   (c) The dimensions of the room(s) concerned.

   (d) The type of occupancy of all adjacent areas inclusive of space above and below the room(s) concerned. If there is an exterior wall, show distance to the closest area(s) where it is likely that individuals may be present.

   (e) The make and model of the x-ray equipment and the maximum technique factors.

   (f) The type of examination(s) or treatment(s) which will be performed with the equipment.

2. Information on the anticipated workload of the x-ray system(s).

3. If the services of a qualified expert have been utilized to determine the shielding requirements, a report, including all basic assumptions used, shall be submitted with the plans.

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